

What is claimed is:

*✓* 1. In a communications receiver having a decision feedback equalizer filter, said communications receiver responsive to a received signal, said communications receiver further having an input filter responsive to said received signal to form soft decision samples corresponding to said received signal, and a slicer responsive to said received signal to form hard decision samples corresponding to said received signal, said soft decision samples and said hard decision samples comprising a series of individual signal samples, a method for operating said decision feedback equalizer filter comprising:

operating said decision feedback equalizer filter in a first mode by coupling said soft decision samples to said decision feedback equalizer filter;

operating said decision feedback equalizer filter in a second mode by coupling said hard decision samples to said decision feedback equalizer filter; and

switching between first and second modes on an individual signal sample basis.

2. A method in accordance with claim 1, wherein said steps of switching between first and second modes on an individual signal sample basis comprise switching between said first and second modes in accordance with the quality of said individual signal sample, said steps comprising:

measuring the quality level of said individual signal sample;

PENTECOST - DRAFTED - 10/10/00

coupling an individual one of said soft decision samples to said decision feedback equalizer filter when said quality of said individual signal sample is at a first quality level; and

coupling an individual one of said hard decision samples to said decision feedback equalizer filter when said quality of said individual signal sample is at a second quality level,

wherein said second quality level is greater than said first quality level.

3. A method in accordance with claim 2, wherein said signal samples are represented as constellation points in a complex plane, and wherein said individual signal sample is at a first quality level when outside a box of width  $w$ , said box of width  $w$  being centered about the origin of said complex plane, and said individual signal sample is at a second quality level when inside said box of width  $w$ , centered about the origin of said complex plane.

4. A method in accordance with claim 2, wherein said signal samples are represented as constellation points in a complex plane, and wherein said individual signal sample is at a first quality level when outside a box of width  $w$ , said box of width  $w$  being centered about the origin of said complex plane, and said individual signal sample is at a second quality level when inside said box of width  $w$ , centered about the origin of said complex plane and the least means square error of said individual signal sample is below a threshold  $t$ .

5. A method in accordance with claim 4, wherein said threshold  $t$  is represented as a reliability area comprising a circle in said complex plane.
6. A method in accordance with claim 4, wherein said threshold  $t$  is represented as a reliability area comprising a box in said complex plane.
7. A method in accordance with claim 3, wherein the width  $w$  of said box is adaptive based on the qualities of a block of past signal samples.
8. A method in accordance with claim 4, wherein said threshold  $t$  is adaptive based on the qualities of a block of past signal samples.
9. A method in accordance with claim 1, wherein said first mode is a signal acquisition mode using said soft decision samples and the constant modulus algorithm to update the error terms of said feedback equalizer filter.
10. A method in accordance with claim 1, wherein said second mode is a signal tracking mode using said hard decision samples and the least means squared algorithm to update the error terms of said feedback equalizer filter.
11. In a communications receiver having a decision feedback equalizer filter, said communications receiver responsive to a received signal, said communications receiver further having an input filter responsive to said received signal to form soft decision samples corresponding to said received signal, and a slicer responsive to said received

signal to form hard decision samples corresponding to said received signal, said soft decision samples and said hard decision samples comprising a series of individual signal samples, a decision feedback equalizer filter arrangement comprising:

a first switch operable responsive to a first mode, to couple said decision feedback equalizer filter to said soft decision samples, said first switch further operable responsive to a second mode, to couple said decision feedback equalizer filter to said hard decision samples; and

a switch control responsive to individual signal samples to operate said first switch to select one of said first and second modes.

12. An apparatus in accordance with claim 11, wherein said decision feedback equalizer filter is operated in said first and second modes in accordance with the quality of said individual signal sample, said decision feedback equalizer filter mode being operated in said first mode by said switch control when said quality of said individual signal sample is at a first quality level, said decision feedback equalizer filter mode being operated in said second mode by said switch control when said quality of said individual signal sample is at a second quality level, wherein said second quality level is greater than said first quality level.

13. An apparatus in accordance with claim 12, wherein said signal samples are represented as constellation points in a complex plane, and wherein said individual signal sample is at a first quality level when outside a box of width  $w$ , said box of width  $w$  being centered

0 9 8 7 6 5 4 3 2 1 0

about the origin of said complex plane, and said individual signal sample is at a second quality level when inside said box of width  $w$ , centered about the origin of said complex plane.

14. An apparatus in accordance with claim 12, wherein said signal samples are represented as constellation points in a complex plane, and wherein said individual signal sample is at a first quality level when outside a box of width  $w$ , said box of width  $w$  being centered about the origin of said complex plane, and said individual signal sample is at a second quality level when inside said box of width  $w$ , centered about the origin of said complex plane and the least means square error of said individual signal sample is below a threshold  $t$ .

15. An apparatus in accordance with claim 4, wherein said threshold  $t$  is represented as a reliability area comprising a circle in said complex plane.

16. An apparatus in accordance with claim 4, wherein said threshold  $t$  is represented as a reliability area comprising a box in said complex plane.

17. An apparatus in accordance with claim 13, wherein the width  $w$  of said box is adaptive based on the qualities of a block of past signal samples.

18. An apparatus in accordance with claim 14, wherein said threshold  $t$  is adaptive based on the qualities of a block of past signal samples.

19. An apparatus in accordance with claim 11, wherein said first mode is a signal acquisition mode using said soft decision samples and the constant modulus algorithm to update the error terms of said feedback equalizer filter.

20. An apparatus in accordance with claim 11, wherein said second mode is a signal tracking mode using said hard decision samples and the least means squared algorithm to update the error terms of said feedback equalizer filter.

21. In a communications receiver having a decision feedback equalizer filter, said communications receiver responsive to a received signal, said communications receiver further having an input filter responsive to said received signal to form soft decision samples corresponding to said received signal, and a slicer responsive to said received signal to form hard decision samples corresponding to said received signal, said soft decision samples and said hard decision samples comprising a series of individual signal samples, an apparatus for operating said decision feedback equalizer filter comprising:

means for operating said decision feedback equalizer filter in a first mode by coupling said soft decision samples to said decision feedback equalizer filter;

means for operating said decision feedback equalizer filter in a second mode by coupling said hard decision samples to said decision feedback equalizer filter; and

means for switching between first and second modes on an individual signal sample basis.

*Attal M*